SPROUTING OF CHAPARRAL BY DECEMBER AFTER A WILDFIRE IN JULY

by T. R. Plumb

TECHNICAL PAPER No. 57 - MAY 1961

PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION
BERKELEY, CALIFORNIA

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

SPROUTING OF CHAPARRAL BY DECEMBER AFTER A WILDFIRE IN JULY

By
T. R. Plumb

Contents

Technical Paper 57 May 1961
U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION
Berkeley 1, California

SPROUTING OF CHAPARRAL BY DECEMBER AFTER A WILDFIRE IN JULY

By
T. R. Plumb

In July 1960 a wildfire burned about 15,000 acres of chaparral in the San Dimas Experimental Forest in southern California. The fire was extremely hot, consuming most of the heavy brush stems over large areas (fig. 1). Sprouting of the shrubs was measured to determine how quickly they grew after such a clean burn early in the summer.

Brush sprouts and seedlings play an important role in establishing a new protective soil cover after chaparral has burned (Horton and Kraebel, 1955), but growth of native vegetation ordinarily is sparse during the first few years. Consequently, grass or mustard is sown to provide a temporary cover. We wished to learn if the sprouts after a July fire would provide more cover than normally found after a typical autumn fire. We also were interested in knowing how brush regenerated on experimental areas which had been sprayed with 2,4-D and 2,4,5-T before the fire. And, we wondered if sprouts on previously unsprayed brush would be too large for effective spraying the next spring where spraying is necessary to control vegetation for fuel-breaks or for water-yield improvement.

Figure 1.--The charred remains of the San Dimas Experimental Forest. In a little more than 24 hours more than 40 years of brush growth went up in smoke.

THE STUDY

The Experimental Forest is situated on the south slope of the San Gabriel Mountains in typical steep topography at elevations of 1,500 to 5,000 feet above sea level. The chaparral vegetation before the fire was predominantly a combination of chamise and mixed species dominated by scrub oak (Sinclair, Hamilton, and Waite, 1953). Woodland-chaparral occurred above 4,500 feet elevation and on some north slopes and canyon bottoms at lower elevations. Riparian woodland was present in the larger streambeds.

OBSERVATIONS OF NATURAL VEGETATION

Sprout development on unsprayed brush which had not been burned for 40 years or longer, was recorded along contour trails traversing typical topographic conditions at 2,100, 3,100, and 4,100 feet elevations. Two transects, each about 1 mile long, were located at each elevation. At intervals of 4 paces along each transect a point was established, and for the shrub nearest this point a record was made of: species, number of sprouts, and height of sprouts. Slope exposure was recorded along with the pertinent notes. Similar records were made on 1/2 mile of transect on a nearby area which also had been burned in July.

Rate of sprout growth for chamise and scrub oak was measured on six plots. A single sprout on each of several plants on the different plots was tagged and measured periodically for 19 to 31 days.

OBSERVATIONS OF SPRAYED VEGETATION

Sprout development on sprayed vegetation in Bell Canyon was estimated by walking over areas where mature brush had been sprayed in the spring of three consecutive years, 1958, 1959, and 1960. Forty acres had been sprayed by helicopter with a 50/50 mixture of low volatile esters of 2,4-D and 2,4,5-T, at 6 pounds acid equivalent per acre in each application.

Resprouting of live oak stumps was observed along the stream bottom in Monroe Canyon where the trees had been cut and the stumps treated with a 2,4-D and 2,4,5-T mixture in the spring of 1958 and 1959. Sprouts which grew on treated stumps had been sprayed by hand either once or in two consecutive years. Sprout height and number were recorded for 67 stumps which had resprouted and had been sprayed before the fire.

RESULTS AND CONCLUSIONS

Sprouts started emerging from the crowns of many burned shrubs and trees within 10 days after the fire. Riparian species sprouted almost immediately and continued growing through the fall. Sprouts on some scrub oak and sugarbush plants were 8 to 10 inches tall and growing vigorously

by mid-August. Sprouts of most species were readily visible over the entire Experimental Forest by early September. However, at all elevations many plants of most species had not sprouted.

SPROUTING OF NATURAL VEGETATION

Sprouting continued through the fall on shrubs which had not been chemically treated before the fire. This is illustrated by the percent of observed plants producing sprouts for six important species at two dates, 3 months and 4-1/2 months after the fire:

	Percent of Plants Sprouting	
Species	November	December
Chamise	37	56
Scrub oak	49	70
Toyon	60	71
Laurel sumac	100	100
Sugarbush	64	97
Canyon live oak	56	66

Sprouting was more prevalent at the lower elevations on each observation date. Some species resprouted more quickly than others. For example, in Rhus species, such as laurel sumac and sugarbush, almost all plants had sprouted by December (table 1). To some extent this reflects resistance to killing by fire as well as the capacity to resprout quickly.

In other species, particularly chamise, the low percent of sprouts in December was probably due to fire-caused mortality. In previous studies about half of the chamise plants were killed by hot summer fires (Buttery, Bentley, and Plumb, 1959; Horton and Kraebel, 1955). However, observations on previous burns suggest that additional sprouts will appear later in the growing season on some plants that appear to be dead or sprouting only lightly in December.

One species, Eastwood manzanita, which commonly is not killed by fire, had produced a few sprouts by December. Apparently it has low capacity for early sprouting.

The more limited samples on the other burn showed nearly the same degree of sprouting of the different species as found on the Experimental Forest. About 5 to 10 percent fewer plants were sprouting and the sprouts were smaller.

by mid-August. Sprouts of most species were readily visible over the entire Experimental Forest by early September. However, at all elevations many plants of most species had not sprouted.

SPROUTING OF NATURAL VEGETATION

Sprouting continued through the fall on shrubs which had not been chemically treated before the fire. This is illustrated by the percent of observed plants producing sprouts for six important species at two dates, 3 months and 4-1/2 months after the fire:

	Percent of Plants Sprouting	
Species	November	December
Chamise	37	56
Scrub oak	49	70
Toyon	60	71
Laurel sumac	100	100
Sugarbush	64	97
Canyon live oak	56	66

Sprouting was more prevalent at the lower elevations on each observation date. Some species resprouted more quickly than others. For example, in Rhus species, such as laurel sumac and sugarbush, almost all plants had sprouted by December (table 1). To some extent this reflects resistance to killing by fire as well as the capacity to resprout quickly.

In other species, particularly chamise, the low percent of sprouts in December was probably due to fire-caused mortality. In previous studies about half of the chamise plants were killed by hot summer fires (Buttery, Bentley, and Plumb, 1959; Horton and Kraebel, 1955). However, observations on previous burns suggest that additional sprouts will appear later in the growing season on some plants that appear to be dead or sprouting only lightly in December.

One species, Eastwood manzanita, which commonly is not killed by fire, had produced a few sprouts by December. Apparently it has low capacity for early sprouting.

The more limited samples on the other burn showed nearly the same degree of sprouting of the different species as found on the Experimental Forest. About 5 to 10 percent fewer plants were sprouting and the sprouts were smaller.

Table 1.--Resprouting of chaparral browse plants approximately 4-1/2 months after a fire

Species	2,100 feet		3,100 feet		4,100 feet		Total	
	No. of plants 1/	Sprouting	No. of plants	Sprouting	No. of plants	Sprouting	No. of plants	Sprouting
		Percent		Percent		Percent		Percent
Chamise	169	62	271	61	195	44	635	56
Scrub oak	118	78	25	68	118	64	261	70
Toyon	45	76	29	66	5	60	79	71
Laurel sumac	31	100	0	0	0	0	31	100
Sugarbush	0	0	30	97	0	0	30	97
Canyon live oak	26	73	0	0	30	60	56	66
Bigberry manzanita 2/	0	0	22	0	98	0	120	0
Eastwood "	0	0	27	26	59	17	86	20
Sage	92	45	69	13	2	100	163	31
Hoary-leaf ceanothus 2/	0	0	38	0	0	0	38	0
Hairy "	0	0	0	0	2	50	2	50
Lemonade berry	9	89	0	0	1	100	10	90
Yerba santa	1	100	23	61	14	86	38	71
Mountain mahogany	9	78	7	57	12	58	28	64
Silktassel	3	0	19	58	23	48	45	47
Hollyleaf cherry	0	0	13	85	4	100	17	88
Rhamnus	18	72	0	0	2	100	20	75
Coast live oak	25	88	0	0	0	0	25	88
Laurel	3	100	0	0	2	100	5	100
Ribes	12	92	1	0	0	0	13	85

1/ The number of sprouts in the sample of each species is indicative of its abundance in the chaparral cover

2/ Non-sprouting chaparral species.

Factors Affecting Sprout Development

Of the two factors commonly considered as regulating growth of chaparral (Horton, 1960; Miller, 1947), soil moisture appeared to be more important than temperature in determining sprout growth. Lower temperatures at 4,100 feet elevation, however, may have caused the somewhat lower percent of plants sprouting at that elevation.

The most apparent differences in sprout development were related to site conditions (figs. 2-6). Near the base of slopes where soil was deepest and moisture conditions appeared most favorable, most plants were sprouting. High on the slopes, where soil was shallow and rocky, few plants had produced sprouts. This was particularly true of scrub oak (fig. 2). Position of the plants on the slope, rather than exposure of the slope, appeared to have most influence on the sprout development.

The cumulative effects of two dry years before the fire may have influenced sprouting. Had more soil moisture been available at the time of the fire in July when temperatures were high, early sprout growth might have been greater at the higher elevations.

Growth and Size of Sprouts

Growth rate was extremely variable for different plants of the same species. For example, many scrub oak sprouts were 2 to 3 feet tall by November but did not lengthen during the next month. Others grew 4 to 6 inches during that period. Chamise sprouts that were 6 inches high early in November grew slowly during the next month, while sprouts emerging after mid-November grew to 4-1/2 inch height early in December.

By December the sprouting plants of different species differed greatly in the amount of new vegetation. The chamise plants which were sprouting had produced less than 12 sprouts on two-thirds of the plants and almost all were less than 12 inches high, with about half of them under 6 inches (table 2). Scrub oak had produced about the same number of sprouts per plant, but most of them were more than 12 inches high. Laurel sumac had sprouted most profusely of the six species measured, three-fourths of the plants having sprouts well over 12 inches in height.

Obviously, the dominant shrubs, chamise and scrub oak, did not produce enough foliage to add greatly to the soil protective cover. Other more leafy, shrubs were not sufficiently abundant for soil cover. In fact, the unburned stubs of the shrubs gave more soil cover than did the new foliage from sprouts. No brush seedlings were noted, and herbaceous species, where present, were still in the cotyledon and first-leaf growth stages. Overall, the soil protection from native species was minimal in December.

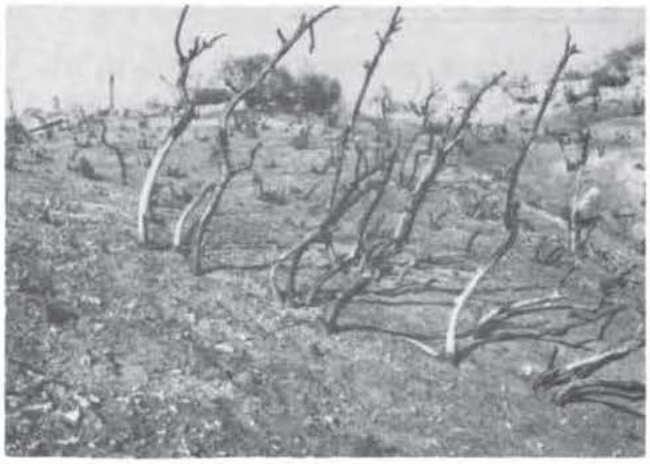

Figure 2.--Scrub oak located on an open ridgetop had not sprouted 4-1/2 months after the fire.

Figure 3.--Where scrub oak on an open ridge had begun to sprout about 4 months after the fire ...

...most of the sprouts were less than 8 inches tall, but were succulent and growing fairly vigorously.

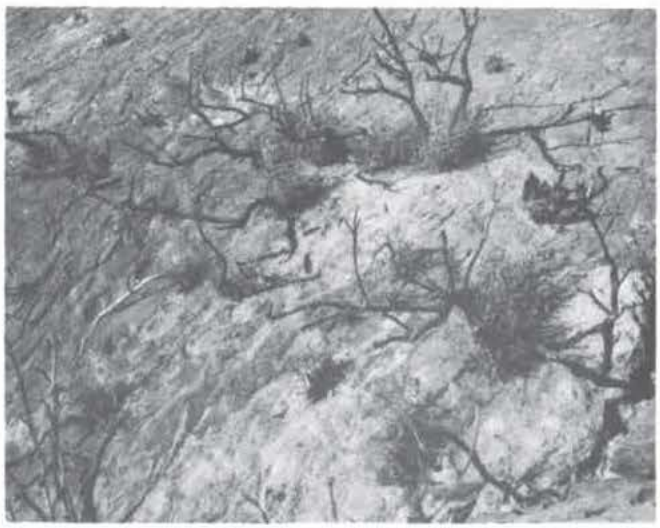

Figure 4.--These scrub oaks, located along a small draw, produced large clumps of sprouts 2-3 feet tall within 4 months after the fire.

Figure 5.--Chamise located along a ridge did not resprout by November, four months after the fire.

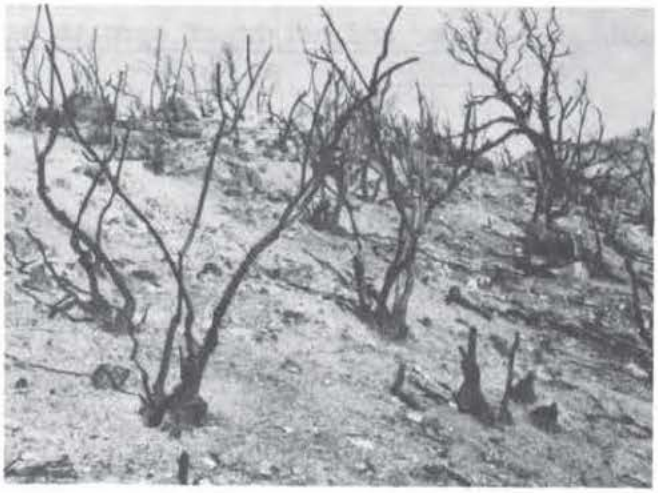

Figure 6.--But chamise located along a small draw developed many sprouts by November.

The sprouts shown here were 1 to 10 inches tall and growing actively.

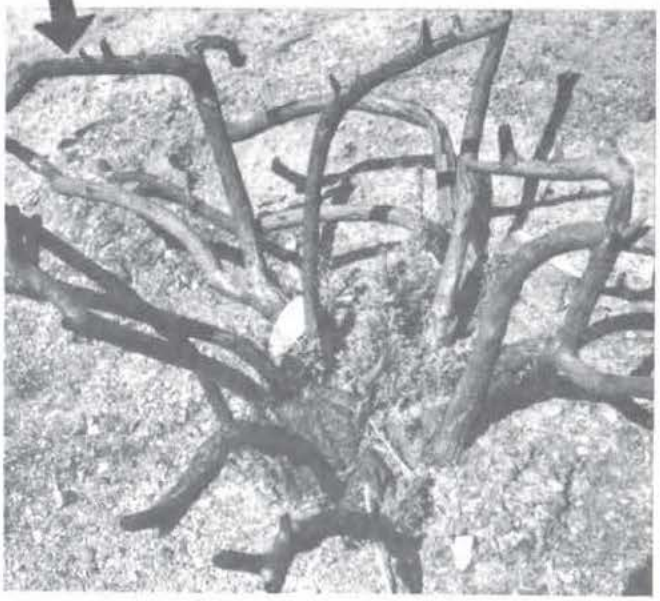

Table 2.--Number and height of sprouts per plant on six shrub species in December

Species	Height of sprouts per plant			Number of sprouts per plant		
	Less than 6 inches	6 to 12 inches	More than 12 inches	Less than 6	6 to 12	More than 12
	Percent of plants			Percent of plants		
Chamise	47	43	10	35	34	31
Sage	88	12	0	37	33	30
Laurel sumac	3	0	97	10	16	74
Scrub oak	15	19	66	44	32	24
Toyon	10	45	45	14	34	52
Silktassel	62	29	9	29	24	47

The size of most sprouts indicated that they should not be too large for effective chemical spraying in the spring. In fact, earlier treatment would be undesirable since it is probable that many potential sprouts had not developed by December.

OBSERVATIONS OF SPRAYED VEGETATION

Where mature brush in Bell Canyon had been sprayed three times by helicopter, the extent of sprouting after the fire differed by species and site. In general, the chamise-ceanothus association on the ridges had not produced sprouts. Here, most or all of the brush apparently had been killed by the chemical and was completely consumed by the fire (fig. 7a). Adjacent to these denuded ridgetops many of the chamise resprouted after the fire and the sprouts died back. On the side slopes where vegetation was dominated by broadleaved species, such as scrub oak and toyon, the crop of sprouts appeared to be as heavy as, or heavier than on unsprayed areas (fig. 7b). Apparently three broadcast applications of brushkiller and a wildfire were not successful in killing these plants. In both sites, spring sampling will be needed to judge the effects of the spraying.

In Monroe Canyon, the fire appeared to stimulate sprouting of chemically sprayed stumps. Sprouts that had been topkilled by the chemical were burned as the fire was carried from stump to stump in grass fuels. Resprouting started within 10 days after burning (fig. 8). About 90 percent of the stumps produced sprouts (table 3). Those which had been sprayed twice, in consecutive years, had fewer and smaller sprouts than those sprayed once.

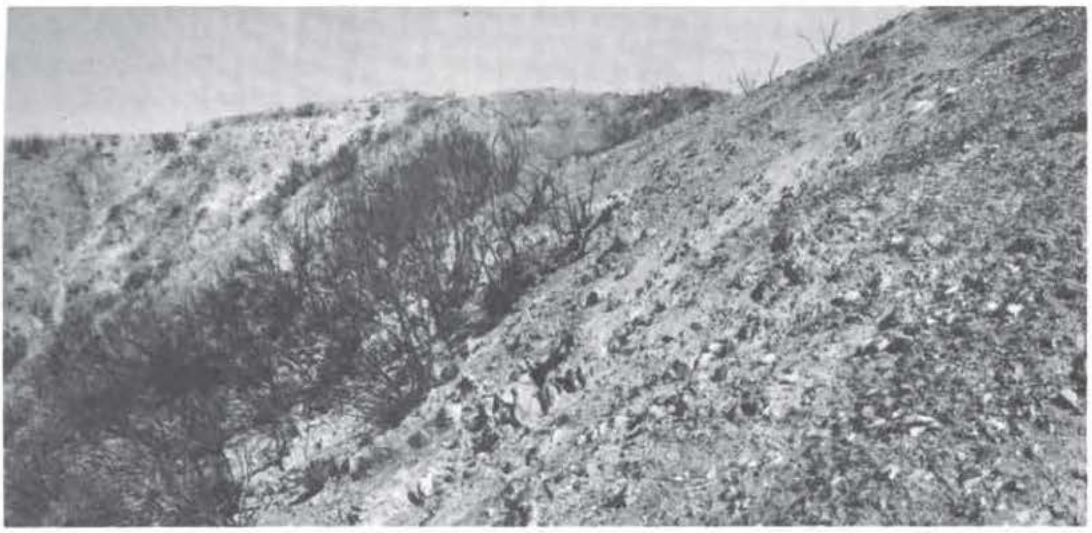

Figure 7a.--This area in Bell Canyon was sprayed three times with brushkiller prior to the wildfire. The broadleaved chaparral on the left is sprouting vigorously. On the right, an area of chamise and ceanothus, the aerial plant parts were completely consumed. Little or no sprouting has occurred here.

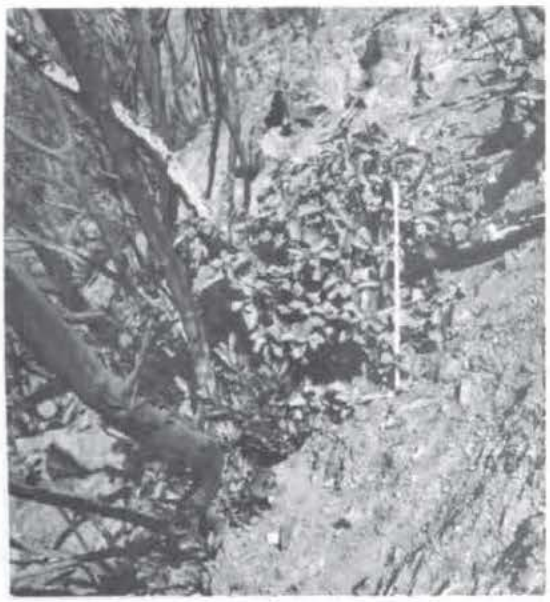

Figure 7b.--This sugarbush produced sprouts 2-2½ feet tall. Three annual applications of brushkiller and a wildfire have not noticeably sapped its vigor.

Figure 7c.--This charred stump--chamise or ceanothus?--is typical of all that remains of the original cover on the hotly burned areas shown above.

Figure 8.--This scrub oak stump was sprayed with brushkiller in the spring and burned the following July. Resprouts were numerous and 6 to 12 inches tall by December.

To sum up, sprouts emerged from many of the woody plants within 10 days after a fire swept the San Dimas Experimental Forest. But sprouting varied with both species and location. Most regrowth occurred along the moist draws and stream channels. By December the dominant shrubs, chamise and scrub oak, had not produced enough foliage to provide much soil protection. Over the entire forest, the charred stems probably provided about as much cover as the new sprout foliage.

Table 3.--Sprouting of live oak stumps, treated with one or two annual herbicidal applications, 5 months after burning by wildfire

Number of chemical applications	Total no. of stumps	No. of stumps not sprouting	Number of sprouts			Height of sprouts		
			Less than 6	6 to 12	More than 12	Less than 6 in.	6 to 12 in.	More than 12 in.
One	33	3	5	3	22	0	1	29
Two	34	4	10	5	15	1	8	21
Total	67	7	15	8	37	1	9	50

REFERENCES

Buttery, R. F., Bentley, J. R., and Plumb, T. R.
1959. Season of burning affects follow-up chemical control of sprouting chamise. Pacific Southwest Forest and Range Expt. Sta. Res. Note 154.

Horton, J. S., and Kraebel, J. C.
1955. Development of vegetation after fire in the chamise chaparral of southern California. Ecology 36(2).

Horton, Jerome S.
1960. Vegetation types of the San Bernardino Mountains. Pacific Southwest Forest and Range Expt. Sta. Tech. Paper 44.

Miller, Erwin H.
1947. Growth and environmental conditions in southern California chaparral. The American Midland Naturalist 37(2): 379-420.

Sinclair, J. D., Hamilton, E. L., and Waite, M. N.
1953. A guide to the San Dimas Experimental Forest. California Forest and Range Expt. Sta. Misc. Paper 11.

COMMON AND SCIENTIFIC NAMES OF WOODY PLANTS SAMPLED IN THIS STUDY

Common Name	Scientific Name
Bigberry manzanita	Arctostaphylos glauca
Bigleaf maple	Acer macrophyllum
Black sage	Salvia mellifera
California sycamore	Platanus racemosa
Canyon live oak	Quercus chrysolepis
Chamise	Adenostoma fasciculatum
Coast live oak	Quercus agrifolia
Eastwood manzanita	Arctostophylos glandulosa
Evergreen buckthorn	Rhamnus crocea var. ilicifolia
Hairy ceanothus	Ceanothus oliganthus
Hoary-leaf ceanothus	Ceanothus crassifolius
Hollyleaf cherry	Prunus ilicifolia
Laurel	Umbellularia californica
Laurel sumac	Rhus laurina
Lemonade berry	Rhus intergrifolia
Mountain mahogany	Cercocarpus betuloides
Ribes spp.	Ribes sp.
Scrub oak	Quercus dumosa
Silktassel	Garrya veatchii
Sugarbush	Rhus ovata
Toyon	Photinia arbutifolia
White alder	Alnus rhombifolia
White sage	Salvia apiana
Yerba santa	Eriodictyon spp.
Yucca	Yucca whipplei